of the English Trias, J. Lomas; extraordinary daily fluctuations in a Karroo well, Prof. A. Young; and other papers on the Karroo or Trias. *Joint meeting with Section E* (*Geography*).—The physical geography of Cape Colony, H. C. Schunke-Holloway; Glacial periods in South Africa, A. W. Rogers; changes of climate, as shown by movements of the snow line and upper tree line since Tertiary times, Prof. A. Penck; physiographical subject, Prof. W. M. Davis; Baviaan's Kloof, a contribution to the theory of mountain folds, E. H. L. Schwarz; the Stormberg formation in the Cape Colony, A. L. Du Toit; on the geology of South Victoria Land, H. T. Ferrar. *Johannesburg:* President's address; magnetic segregation of sulphide ores, Dr. A. P. Coleman; marginal phenomena of granite domes, Prof. G. A. J. Cole; relation of the igneous rocks to the crystalline schists, F. P. Mennell; the indicators of the goldfield of Ballarat, Prof. J. W. Gregory; petrographical subject, Prof. R. B. Young; the diamond pipes and fissures of South Africa, H. S. Harger; recent work of the Transvaal Geological Survey, H. Kynaston; the Victoria Falls, G. W. Lamplugh; the great laccolitic intrusions of the Bushveld, Dr. G. A. F. Molengraaff; evidences in the Transvaal of Glacial conditions in permo-Carboniferous times, E. T. Mellor; geological notes on the excursion to Pretoria, A. L. Hall; the great West Rand upthrust, Dr. J. T. Carrick; notes on a sedimentary formation older than the Witwatersrand beds, E. Jorissen; interesting outlines of the Witwatersrand formation, Dr. J. T. Carrick.

Section D (Zoology).—*Cape Town:* President's address; the Triassic reptiles of South Africa, with remarks on the origin of mammals, Dr. Broom; a comparison of the Permian reptiles of Russia with those of South Africa, Prof. Amalitzky; South African scorpions, Dr. Purcell; recent work on gametogenesis and its bearing on theories of heredity, L. Doncaster; the migration of birds in the southern hemisphere, W. L. Sclater; the ostrich, A. H. Evans. *Johannesburg:* Pearl oysters and pearls, Prof. Herdman; recent discoveries in the South African deep sea, Dr. Gilchrist; cephalodiscus, Dr. Harmer; the growing-point in vertebrates, Prof. Cleland; South African ticks, Drs. Cooper-Foster and Nuttall.

Section E (Geography).—*Cape Town:* President's address; afforestation of South Africa; the unveiling of the coasts of Africa (lantern views of old maps), H. Yule Oldham; the Ordnance Survey of the United Kingdom, Colonel Johnston; a comparison of the periodicity of the meteorological conditions of London and Cape Town, Dr. H. R. Mill; Gough Island, Rudmose Brown; terrestrial globes as a necessary adjunct to the teaching of geography, Captain Creak; excursions as a means of teaching geography (lantern), J. Lomas. *Johannesburg:* The evolution of Africa, Dr. J. Scott Keltie; a new rainfall map of Africa, A. J. Herbertson and P. C. Waite; boundaries and areas in Africa, J. Bolton; the physical geography of the Transvaal, Tudor Trevor; notes on the geography of Africa south of the Limpopo, F. S. Watermeyer; the game preserves of the Transvaal, Major Stevenson Hamilton, D.S.O.; the Sikhim Himalayas and Tibet, Douglas W. Freshfield; Asiatic subject, Prof. Cordier.

Section G (Engineering).—*Cape Town:* Metcalfe on Zambezi Bridge and Rhodesian railways; ocean turbine boats, Prof. Byles; roller bearings, wire ropes in mines, and probably automobiles. *Johannesburg:* President's address (irrigation); strength of winding ropes in mines, Prof. Perry.

Section H (Anthropology).—*Cape Town:* President's address; the totemism of the Bantu, E. S. Hartland; the musical instruments of the natives of South Africa, Hy. Balfour; American Negroes, Miss Pullen-Burry; artificial deformation in Africa, Dr. von Luschan. *Johannesburg:* arts and crafts among the natives of South Africa, Dr. Schoenland; stone implements in South Africa, Mr. Johnstone; bushman paintings with reproductions, Dr. Squire; the affinities of the Hottentots, Dr. von Luschan; the Modjadje, Rev. Reuter; the Bawenda, Rev. Gottschling; report on Zimbabwe, Mr. MacIver; the Basuto, H. E. Mabille.

Section I (Physiology).—*Cape Town:* Discussion on the effect of climate on health, opened by Sir T. Lauder Brunton (Dr. David Ferrier, Prof. McKendrick, Dr. Gregory, Dr. Jasper Anderson, Prof. Bohr, and Dr. J. A. Mitchell will take part); so-called scurvy of South Africa, Dr. Gregory; on plague, Dr. J. A. Mitchell; leprosy in Cape Colony, Dr. A. S. Black; South African drugs, Dr. Moberley; discussion on horse-sickness and allied diseases, opened by Dr. Edington (Dr. Hutcheon, Mr. du Plessis, Dr. Wm. Robertson, Colonel Bruce, and Prof. Sims Woodhead will take part); stock diseases in South Africa, Dr. Hutcheon; ticks as a means of conveying disease in South Africa, Mr. Lounsbury. *Johannesburg:* President's address; horse-sickness, Dr. Theiler; rinderpest, Dr. G. Turner; a discussion on lung diseases in connection with mining (Dr. Sims Woodhead) is under consideration; nervous diseases, Prof. Ferrier; the life-history of coloured labourers in the Transvaal, Dr. D. Macaulay and Dr. Louis Irvine; dysentery, Colonel Cecil Birt.

Section K (Botany).—*Cape Town:* The present position of our knowledge of seaweeds, Prof. R. W. Phillips; the fossil floras of South Africa, A. C. Seward; educational methods in the teaching of botany, Harold Wager; notes on irrigation farming on the Orange River, F. B. Parkinson. *Johannesburg:* President's address; photography as an aid to œcological research, Prof. F. E. Weiss; the problems of heredity, R. P. Gregory. It is expected that Prof. Engler, Prof. Pearson, and others will contribute papers.

Section L (Educational Science).—*Cape Town:* President's address; the teaching of science, Prof. H. E. Armstrong; the teaching of science in South Africa, Dr. Hahn; rural education, appropriate to colonial life in South Africa, and agriculture, A. D. Hall; the higher education of women in South Africa, Miss Clark; disabilities of South African school boys, W. A. Way; Cape education, its difficulties and development, Rev. W. E. C. Clarke. *Johannesburg:* Changes in the Dutch language since its introduction into South Africa, Dr. Brill; education on the veldt, Mr. Corbett; prospects of secondary schools in the Transvaal, Mr. Hope; teaching of agriculture, F. B. Smith; native education, Hobart Houghton; progress of education in the Transvaal, H. Warre Cornish; education in Rhodesia, G. Duthie; a school of forestry, T. R. Simms; the teaching of architecture, R. G. Kirkby; education in the Orange River Colony, Hugh Gunn; manual instruction in the Transvaal, T. Lowden; recent improvements in the training of infants, with special reference to South Africa, Miss Welldon; discussion with Section A, the teaching of elementary mathematics.

THE PRINCIPLES OF GEOLOGY.[1]

THE principles are, notwithstanding the origin of the word, the last things you attain to in the course of scientific investigation; but they are what you first explain to another who is commencing his study. You may make a further selection of such parts as are for any reason the easiest or most suitable for him to begin with, and call them the elements. Lyell's classic work has pretty well fixed what shall be the conventional meaning of "The Principles of Geology." They are the laws or explanations which we arrive at in respect of the phenomena exhibited in the earth's crust from direct observation of those phenomena themselves or of the recent operations of nature which we see producing analogous results. Their value depends upon the opportunities afforded of obtaining evidence and upon the personal faculty of eliminating sources of error.

In the case of geology, the subject is so vast that its different branches are growing further and further apart, until they seem to have an intergrowth with the branches from other subjects the original stem of which was far removed from their own.

From the observation of rock masses inferences have been drawn as to the conditions which prevailed in past times, and theories have been propounded as to the forces which have rolled up the strata and produced such varied superficial and deep-seated phenomena. These form the principles of dynamical geology, and it is the description of the resultant structures and the methods of observation which form the chief subject of the interesting handbook just published by Dr. James Geikie under the title "Structural and Field Geology."

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[1] "Structural and Field Geology." By Dr. Jas. Geikie. Pp. xx + 435. (Edinburgh: Oliver and Boyd; London: Gurney and Jackson, 1905.) Price 12*s*. 6*d*. net.

The two first chapters are devoted to an examination of the rock-forming minerals. These are very few in number if we leave out all except those which are the essential constituents of the common rocks.

After studying their composition and characteristics in hand specimens or small slices adapted for examination under the microscope, there is much to be learnt as to the history of the earth's crust from the observation of large masses of rock. We can see whether they were laid down in comparatively tranquil water, or hurled along by torrents, or dashed against a shore. We notice that what was once mud or sand or shingle is now solid rock, and we try to make out in each case whether this was brought about by the introduction of some cementing material or caused by the pressure of superincumbent masses, and whether the changes were helped by the action of the high temperature experienced by rocks depressed to great depths or crushed by irresistible earth movements. Chemical reactions and the crystallisation of various minerals out of the material of the rock produce changes on a small scale, as seen in concretions and drusy cavities, or on a large scale as in the case of the formation of vast beds of crystalline limestone from the calcareous fragments of various organisms. We can infer from a comparison of certain rocks with the products of recent volcanoes that ancient volcanoes also injected molten matter through the riven rocks, poured out vast sheets of lava, and covered wide areas with volcanic ash.

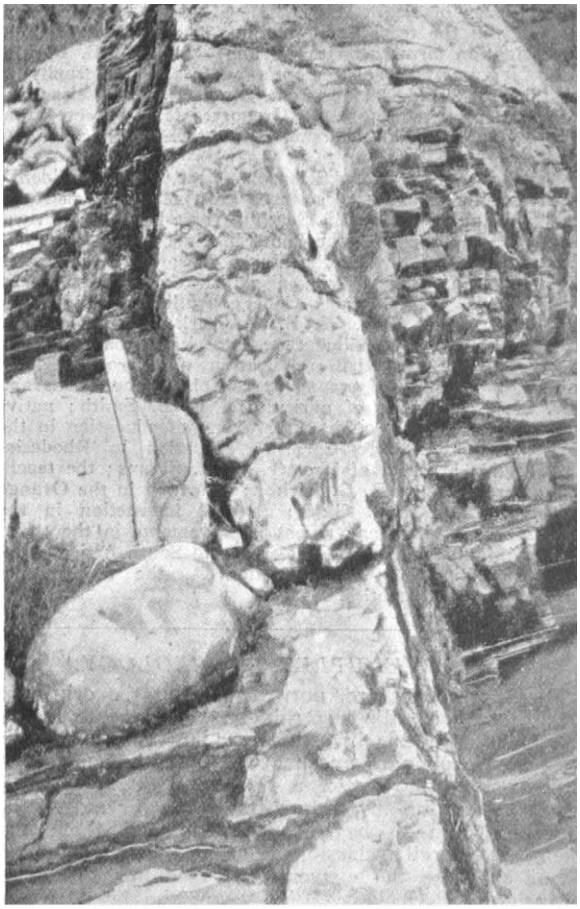

Photo. by H.M. Geological Survey.

Fig. 1.—Fault-rock, River Garry, at Dalnacardoch, Perthshire. (Reproduced on a reduced scale from "Structural and Field Geology," J. Geikie.)

The rocks so formed and so altered have yet to be regarded from another point of view. They have been depressed, uplifted, and thrown into all sorts of positions, now being dragged out, now crumpled up into every variety of fold, the compressible portions often making up by vertical thickening what they lose in horizontal extent, and those that would not yield to such molecular re-arrangement being reduced to the same dimensions by crumpling.

Divisional planes are developed in them, some being due to crush, some to shrinkage, some to the variety in the succession of deposits, and when the strained and bending rock must break it is apt to give along these lines of weakness, so that we find faults commonly coinciding with master joints, thrusts with bedding planes, and so on.

The last seven chapters are more specially devoted to the second subject in the title of the book, namely, field geology. This could not be altogether dissociated from the observations recorded in the earlier part of the work. The information there given is the outcome of original observations in the field, but our author now deals more with the methods employed, and explains what are the most useful appliances for the work and what are the indications which the surveyor must be on the alert to detect. Perhaps, having regard to the numerous monographs which have recently been published on the subject of scenery, he has given greater prominence to the causes than to the effects, to the earth structures to which most scenic features must ultimately be referred rather than to the total result of movement and denudation by which anomalous river flows and abnormal features must be explained.

A study of recent organisms enables us sometimes to establish the relation between the soft and perishable parts and the hard parts which alone are commonly preserved in the rocks, and thus by a comparison of the fossil forms with their nearest recent representatives to learn something of the order of succession of life upon the earth and the conditions under which fossil plants and animals existed. Such analogies must not, however, be pressed too hard. Even such a recent case as the occurrence together of the remains of lion, hyæna, and hippopotamus with the hairy elephant and woolly rhinoceros in our gravel terraces can hardly yet be said to have received an altogether satisfactory explanation. Before we draw inferences from the abundance or rarity of certain fossil organisms we must carefully consider their mode of entombment and the conditions which favour the preservation or the destruction of their remains.

Dr. Geikie has dealt very shortly with these principles of palæontology, but devotes most of his work to the inorganic side of geology.

Even with this limitation of subject the work takes a somewhat encyclopædic character owing to the great number and variety of the observations and inferences which have to be recorded. The treatment is rather dogmatic than critical. With an author so experienced and acute in observation this may be for many an advantage, but students require a discussion of arguments where conclusions differ, and references to other authors where they may find the matters more fully treated which are here of necessity briefly stated.

The formation of ripple marks, for instance, wants fuller explanation than the statement that "they owe their origin to a wave-like motion set up in the semifluid sediment by the water passing over it."

The work is illustrated by a large number of diagrammatic sketches by the author and photographs by members of the staff of the Geological Survey. As examples, we reproduce the pictures of two common phenomena which have many points of general resemblance to one another but a very different origin. Plate xxxix. represents a fissure the strata on either side of which have been relatively displaced by earth movements, either repeatedly in one direction or with a to-and-fro motion, so that the walls of the fissure have been rubbed smooth, fluted, and polished by the movement. The triturated rock and the fragments broken off fill the crack, and this débris is often penetrated by mineral matter and consolidated into a mass harder than the rocks through which it passes. The walls of the fissure are sometimes altered mechanically and by infiltering water to a considerable depth.

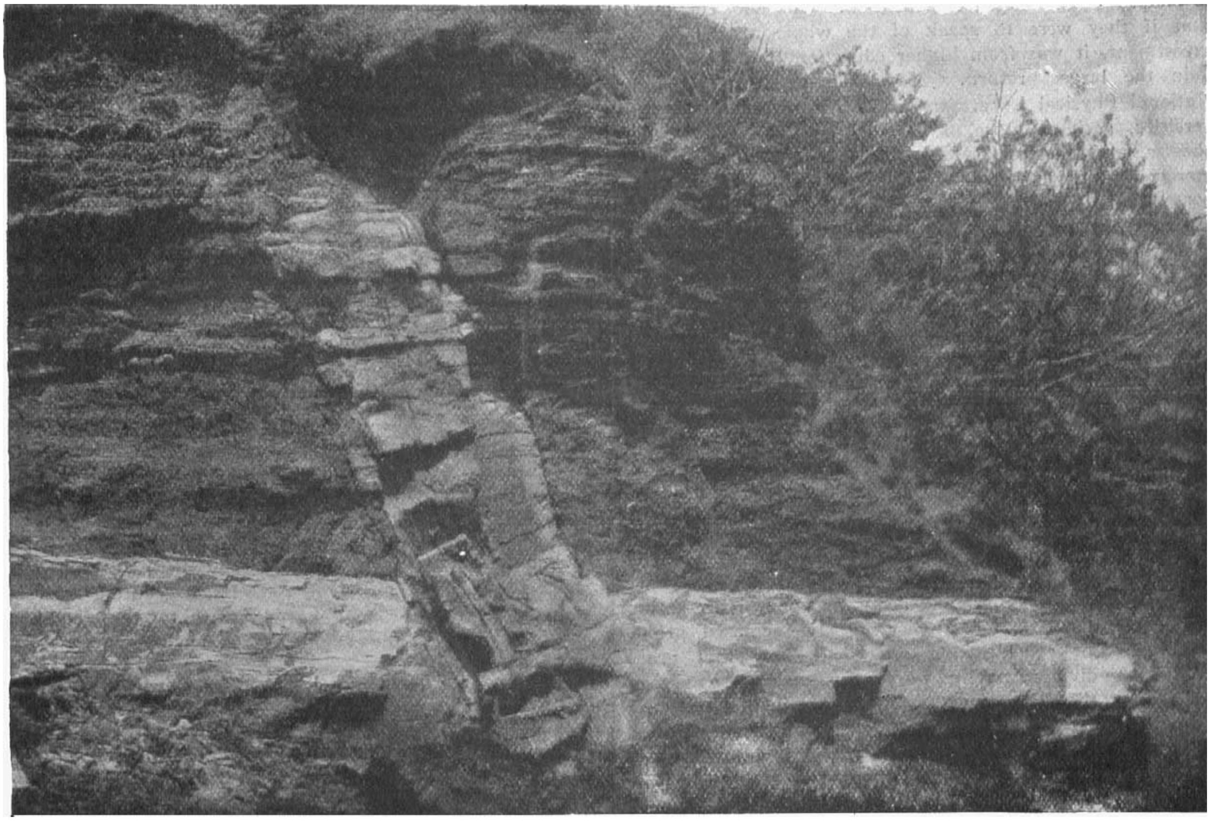

Photo. by H.M. Geological Survey.

Fig. 2.—Basalt Dyke Cutting Sandstone and Shale, Kilbride Bennan, Arran. (From "Structural and Field Geology," J. Geikie.)

In Plate xliv., on the other hand, we see a rift in the rocks filled with matter which has welled up from deep-seated rock which has become molten. In this case, also, the immediately adjoining portion of the rock which it traverses is altered, and very commonly shows slickensides when earth movements have acted upon these two rocks of such different tenacity and hardness; but the composition of the traversing rocks is so unlike in the two cases, and the character of the marginal alterations so dissimilar, that there is seldom any room for doubt as to the origin of each.

Our author has wisely avoided most of the shibboleths which it is the fashion for specialists to introduce into their explanations of the simplest phenomena, but though students may escape the interruption of having to consider the exact application of mylonisation and schillerisation, which are not in the index, though one is found in the text, they must learn the meaning of such terms as synclinorium or geanticline. Difficulties and absurdities in nomenclature are perhaps characteristic of the present phase of scientific literature, and our author has been wonderfully considerate in this matter, and has given us a very useful handbook, admirable in the freshness and terseness of its descriptions and the clearness and abundance of its illustrations.

NOTES.

AMONG those who are the recipients of the King's birthday honours we notice the following:—Lord Rayleigh, O.M., F.R.S., has been made a Privy Councillor; Knighthoods have been conferred upon Prof. T. McCall Anderson, of the University of Glasgow; Mr. E. W. Brabrook, C.B., formerly Registrar of Friendly Societies; Dr. A. B. W. Kennedy, F.R.S., Emeritus professor of engineering and mechanical technology at University College, London, and president of the Admiralty Committee on Machinery Designs; Dr. Boverton Redwood; and Dr. W. J. Smyly, president of the Royal College of Physicians, Ireland. Colonel D. Bruce, F.R.S., has been made a Knight Commander of the Bath. Dr. W. T. Prout, principal medical officer, colony of Sierra Leone, and Dr. J. W. Robertson, late Commissioner of Agriculture and Dairying of the Dominion of Canada, have been made C.M.G.'s. The